Center Innovation Fund: LaRC CIF

Mars Electric Reusable Flyer

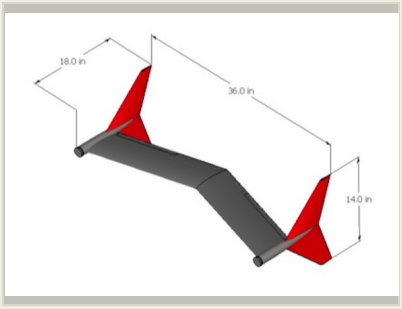
Completed Technology Project (2017 - 2018)

Project Introduction

One of the main issues with a Mars flight vehicle concept that can be reused and cover long distances for maximum surface data gathering is its ability to take off, hover, transition to forward flight and then land safely and precisely. While other Mars flight vehicle concepts have proposed gliding flight with crash landings or low efficiency hovering flight with very little ground coverage, the proposed concept will combine hovering and fast forward flight capability into a single efficient aircraft that can be recharged and reused many times. The extremely low surface pressure on Mars requires new low-Reynolds number, low-density aerodynamics combined with a light-weight structure with extremely low disc loading and low wing loading. The main objectives in FY2017 are: 1) Perform a high altitude balloon drop model test from approximately 100,000 feet to gather key aerodynamic and controls data such as lift coefficient, drag coefficient, and stability characteristics in a relevant environment. An NASA Flight Opportunity Program award has been granted to the project to perform the high altitude balloon drop in the Spring of 2017.2) Begin the investigation of new fabrication techniques that will enable very low weight airframe and propeller designs. These designs may include laser cut carbon fiber frames and durable surface coverings that can withstand low temperatures and dust abrasion over long periods of time. Full-size airframes will be constructed and flown in a 60 foot diameter low pressure chamber at NASA Langley Research Center. 3) Continue flight research on vision-based autonomous navigation (visual odometry / IMU fusion) with a focus on hovering navigation in a 3-D environment simulating extreme terrain such as lava tubes and canyons. The exploration of Mars surface has focused on orbiters that can gather global scale data, and slow-moving rovers that get only local data. Recent advancements in autonomous electronic aircraft controls, structures, batteries and electric propulsion have brought these technologies to a level which will allow reusable electric flight in Mars' ultra-low density atmosphere. This type of asset that can gather data on a regional scale and from extreme terrain locations such as lava tubes and deep canyons. Characteristics of the aircraft must include extremely lightweight and robust structures for low wing loading and propeller disk loading, the ability to hover and perform precision landings in safe zones, battery recharging for repeated flights, and autonomous navigation without a global positioning system. The proposed effort for the FY2017 phase of the project will focus on advancing these key technologies and bring them together in a series of prototype demonstrations in relevant environments such as high altitude drops and low-pressure chamber testing.

Anticipated Benefits

Benefit to science mission directorate for planetary surface exploration



Mars Electric Reusable Flyer

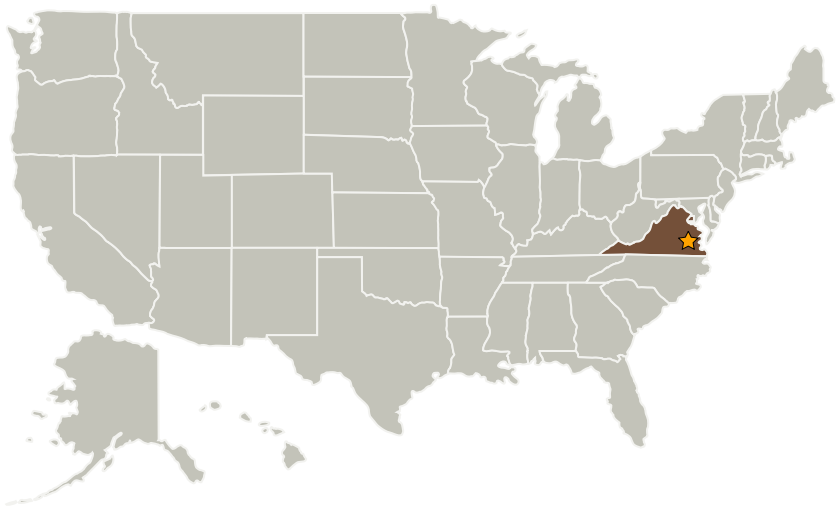
Table of Contents

Center Innovation Fund: LaRC CIF

Mars Electric Reusable Flyer

Completed Technology Project (2017 - 2018)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
Federal Aviation Administration(FAA)	Supporting Organization	US Government	Washington, District of Columbia

Co-Funding Partners	Type	Location
Federal Aviation Administration(FAA)	US Government	Washington, District of Columbia

Primary U.S. Work Locations	
District of Columbia	Virginia

Project Transitions

October 2017: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Center Innovation Fund: LaRC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

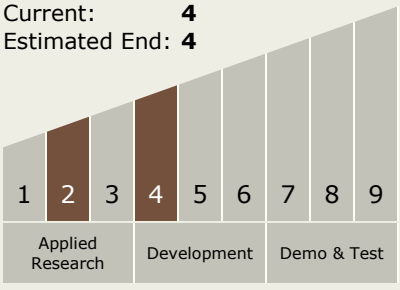
Julie A Williams-byrd

Principal Investigator:

David A North

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



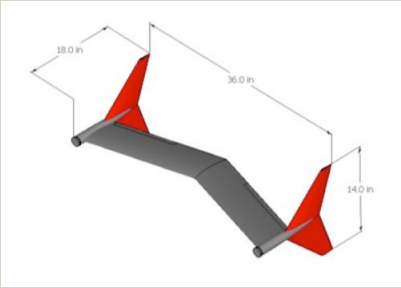
Mars Electric Reusable Flyer

Completed Technology Project (2017 - 2018)

September 2018: Closed out

Closeout Summary: A study was performed to assess the feasibility of a small unmanned VTOL reusable electric flight vehicle concept to support Mars science missions and manned missions. The project has generated several concepts and has selected one for detailed investigation. The project performed bench testing of components, free flight vehicle testing to assess flight controls, GPS-denied n avigation development, wind tunnel testing for low-Reynolds number aerodyna mic performance and flutter characterization, and field testing at a Mars analog t est site to assess use of the system in science and manned mission scenarios.

Images



Project Image
Mars Electric Reusable Flyer
(https://techport.nasa.gov/image/35774)

Project Website:

https://www.nasa.gov/directorates/spacetech/innovation_fund/index.html#.VC

Technology Areas

Primary:

- TX04 Robotic Systems
  - TX04.2 Mobility
    - TX04.2.2 Above-Surface Mobility

Target Destination

Mars